SPORT FISH INVESTIGATIONS OF ALASKA

Annual Performance Report for

Study No. D-I

A Study of Land use Activities and their Relationship of Sport Fish Resources in Alaska

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D-I-B Steven Eliott

TABLE OF CONTENTS

STUDY NO. D-I A STUDY OF LAND USE ACTIVITIES AND THEIR RELATIONSHIP TO THE SPORT FISH RESOURCES IN ALASKA

Job No. D-I-A Establishment of Guidelines for Protection of the Sport Fish Resources During Land Use Activities
By: Dennis Hubartt

Volume 20 Study D-I-A

STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

ESTABLISHMENT OF GUIDELINES FOR PROTECTION OF THE SPORT FISH RESOURCES DURING LAND USE ACTIVITIES

by

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RESEARCH PROJECT SEGMENT

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ABSTRACT

Because of the increasing interagency need for quantitative techniques which may be applied to the evaluation of biological parameters of streams during short-term surveys, project personnel have developed and applied a field technique which provides quantitative information about rearing salmonid fishes and aquatic insects in small streams. The field technique employs the systematic placement of baited minnow traps in the assessment of fish populations and a circular depletion sampler (CDS) in the assessment of aquatic insects.

Baited minnow traps captured Dolly Varden, *Salvelinus malma* (Walbaum), coho salmon, *Oncorhynchus kisutch* (Walbaum), cutthroat trout, *Salmo clarki* Richardson, steelhead and rainbow trout, *Salmo gairdneri* Richardson, chinook salmon, *Oncorhynchus tshawytscha* (Walbaum), threespine stickleback, *Gasterosteus aculeatus* Linnaeus, and sculpin, *Cottus sp.* When sufficient numbers of species of rearing salmonids were captured quantitative measures of the following parameters were obtained: (1) mean catch per unit-effort, (2) species composition, (3) numerical estimates, (4) density estimates, and (5) mean lengths.

Use of the circular depletion sampler (CDS) provided measurements of species composition and numerical estimates of aquatic insect communities.

The main thrust of the current study was to test and modify as necessary a specific sampling design for the assessment of biological parameters which, hopefully, could be incorporated in some sort of standardized survey method

suitable for interagency use. The field techniques were used in eleven different watersheds throughout Southeast Alaska, and the results were a range of values for each of the parameters measured. The field technique did provide useful quantitative measurements of the five parameters in each watershed; but, since the study sites were selected in order to test the techniques in a variety of situations, interpretation of results was limited to the validity and usefulness of the technique and to possible future applications.

BACKGROUND

From its inception in 1970 as a job entitled "Effects of Logging on Dolly Varden" (Reed and Armstrong, 1971) the Land Use Project has focused on various problems associated with land use activities and possible effects on stream ecosystems. The 1970 study was designed to develop techniques for the determination of the status of fish populations prior to land use activities.

Initial studies included general surveys of logged streams throughout Southeast Alaska, an extensive literature review on the subject of the effects of logging on rearing fish, and a continuation of the efforts to develop useful methods for evaluating fish populations. This period of study revealed that further work was needed in two areas: (1) cooperative efforts need to be established with other agencies involved in management activities affecting fish habitat (primarily the U.S. Forest Service), and (2) methods need to be developed to obtain useful information about populations of rearing fish and aquatic insects so that the impacts of land use activities could be assessed (Reed and Elliott, 1972).

In response to these needs, the study was divided into two jobs: "Establishment of Guidelines for Protection of Sport Fish Resources During Logging Operations" (Reed and Elliott, 1973) and "Ecology of Rearing Fish" (Elliott and Reed, 1973). The first job focused on the need to work with other agencies so that important fish habitat could be identified and protected during land use activities. One important product of this job was the publication of a pamphlet which presented guidelines for protecting fish habitat during logging operations (U.S. Forest Service, Alaska Department of Fish and Game, and Alaska Department of Natural Resources, 1973).

The second job developed a series of studies concerning the ecology of rearing fish in a logged watershed and emphasized the development of research techniques which could be used to evaluate the status of rearing fish in small streams in conjunction with changes in the stream environment. These two jobs continued with similar objectives from 1973 through 1976.

Throughout the time period from 1974 through 1976 the "Guidelines" job attempted to identify and protect sport fish resources by participating in multi-disciplinary surveys (MDT's) and inter-disciplinary surveys (IDT's) conducted by the U.S. Forest Service; conducting post-logging

surveys to evaluate the effects of recommendations made during MDT or IDT surveys; reviewing and commenting on Environmental Analysis Reports (EAR's), Environmental Impact Statements (EIS's), and land use mangement plans; and conducting short-term surveys in areas to be or being affected by land use activities (see Annual Reports: Reed, 1974; Dinneford, 1975; Dinneford, 1976; and Hubartt, 1977).

In the fall of 1976 the U.S. Forest Service began developing a land use management plan for the Tongass National Forest which encompasses most of Southeast Alaska. Project personnel actively participated in the planning process through an interagency Fisheries Task Force (FTF). The FTF was assigned the task of identifying, evaluating and prioritizing fisheries resource values in the Tongass National Forest. During the process of assembling and evaluating the available information about the fisheries resources in Southeast Alaska, it became apparent that the existing information about streams and stream habitat did not cover every watershed and was not of a uniform quality. The sparsity of information needed for basic land use management planning is reflected by the fact that less than 30 percent of the streams that had been identified by the Alaska Department of Fish and Game as important to anadromous fishes were rated by the FTF. The rating system was designed to evaluate and prioritize the following data:

Fish species presence and abundance
Available spawning areas
Shellfish species presence and use
System morphology and estuarine areas
Rare or unique fish populations
Important sport fishing areas
Areas with critical habitat
Areas of scientific interest
Rehabilitated or enhanced areas
Areas of exceptional productivity
Areas with enhancement potential
Areas with unique management situations
Streams with barriers to salmon migration
Lakes important to anadromous fish
Dolly Varden overwintering lakes
Important steelhead, cutthroat, and rainbow trout areas

Even in those systems that were rated, the data was frequently incomplete (see Fisheries Task Force Working Report, 1978). The realization of the need for basic information about stream environments was a major factor in shaping the current study (Hubartt, 1978).

During the course of the Starrigavan Study (Elliott, 1978), techniques for assessing the status of populations of rearing salmonids in small streams had been devised. One problem with these techniques was that although they had worked well during the continuing study at the Starrigavan watershed near Sitka, they hadn't been tested in the varying conditions associated with streams throughout Southeast Alaska. Because of the

pressing need for the development of short-term stream survey techniques that would provide quantifiable information about fish communities and stream environments, and that could be used by various land managing agencies in the decision making process; Sport Fish Land Use Project personnel decided to apply the techniques and skills that had been developed during the Starrigavan study to several areas in Southeast Alaska to determine the feasibility of obtaining reliable information about fish and aquatic insects during short-term surveys.

In order to test the techniques for assessing fish populations in a wide variety of situations, areas were selected throughout Southeast Alaska which included anadromous and non-anadromous streams, single and multiple species streams, lake and non-lake systems, streams in rural and urban areas, and logged and unlogged streams. The areas studied are shown in Figure 1. All species discussed in this report are listed in Table 1.

RECOMMENDATIONS

Research

1. A continued effort should be made to identify waters important to the sport fish resources and provide recommendations to protect this resource during land use activities. Cooperation with the U.S. Forest Service is required and should be accomplished by:

    a. Providing resource information during the land use allocation process.

    b. Monitoring the allocation and implementation phases of the planning process to ensure the identification and protection of important sport fish resources.

    c. Participating in interagency efforts to improve techniques for obtaining resource information necessary for proper land use management.

    d. Participating in field surveys as required to determine recreational potential, access to the sport fishery, distribution and abundance of juvenile fishes, critical habitat, and environmentally sensitive areas.

2. The effort to develop and refine field techniques for the quantitative evaluation of populations of rearing salmonids and aquatic insects should be continued by:

    a. Determining if catch per unit-effort data from minnow traps can be used as either an index or an estimator of the numbers of rearing salmonids in small streams.

    b. Determining if differences in aquatic productivity exist between streams in logged and unlogged watersheds.

Table 1. List of common names, scientific names, and abbreviations.

Common Name	Scientific Name and Author	Abbreviation
Dolly Varden	*Salvelinus malma* (Walbaum)	DV
Coho salmon	*Oncorhynchus kisutch* (Walbaum)	SS
Chinook salmon	*Oncorhynchus tshawytscha* (Walbaum)	KS
Cutthroat trout	*Salmo clarki* Richardson	CT
Steelhead - Rainbow trout	*Salmo gairdneri* Richardson	RT
Threespine stickleback	*Gasterosteus aculeatus* Linnaeus	TST
Sculpins	*Cottus* sp.	

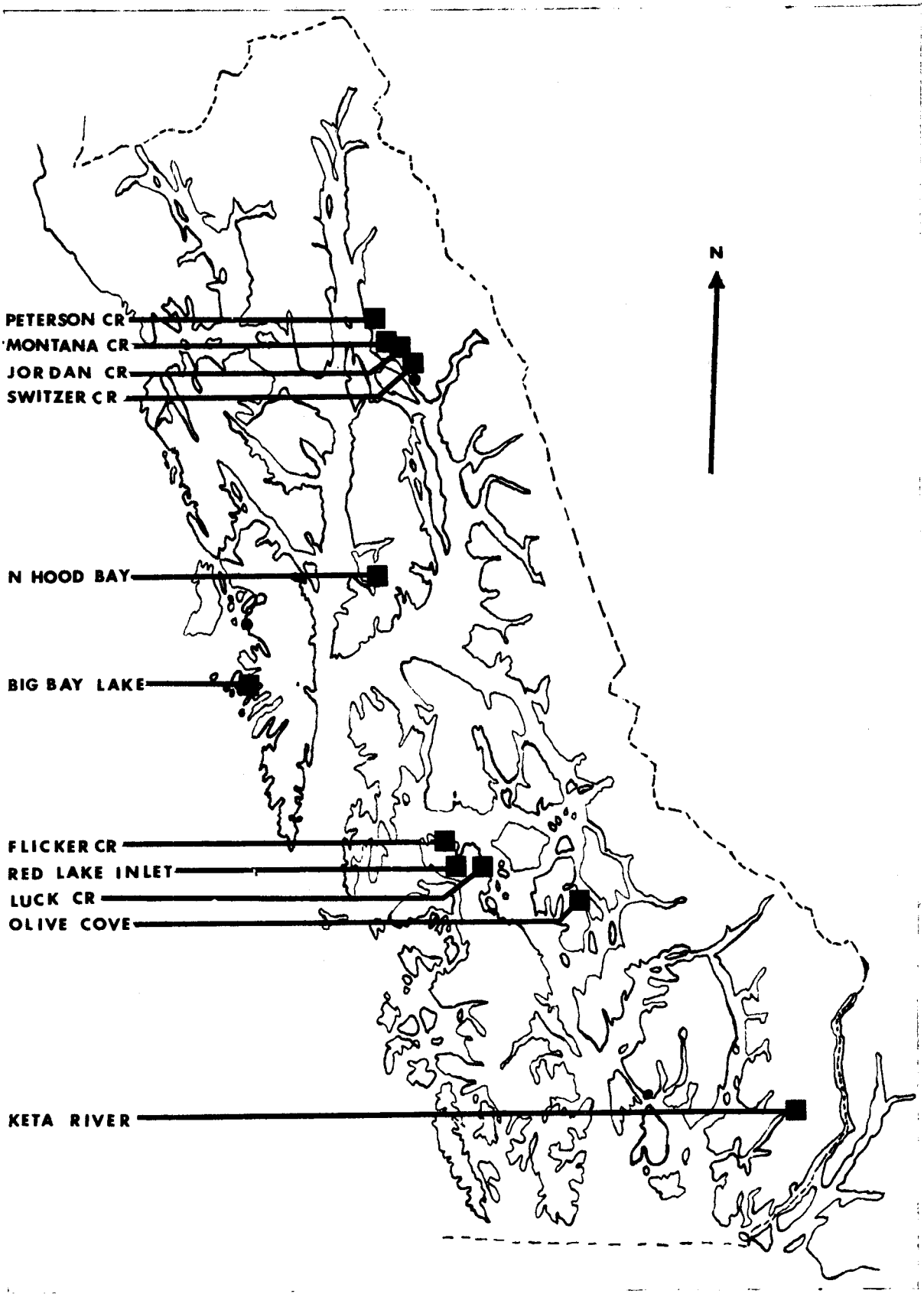

Figure 1. Location of Study Sites, 1978.

c. Determining if differences in overwinter survival exist between streams in logged and unlogged watersheds.

d. Determining the numbers of rearing Dolly Varden in Montana Creek.

3. Evaluation of the effectiveness of recommendations and guidelines made available to land managing agencies should be continued.

Management

1. Because of the continuing uncertainties regarding the designations of lands in Southeast Alaska, project personnel should continue to monitor such changes and provide relevant information to area biologists.

2. Efforts should be continued to develop an efficient data filing and retrieval system for sport fish resources information in cooperation with the Sport Fish Catalog and Inventory Project Leader, other divisions within the Department of Fish and Game, and with Federal agencies.

3. Techniques which have been developed for assessing the status of populations of rearing salmonids and aquatic insects should be applied to specific management problems as necessary, and should be continually tested, improved, and modified to fit management needs.

OBJECTIVES

1. To designate waters important to the sport fish resources and make recommendations to protect this resource during land use activities.

2. To determine the effectiveness of recommendations and guidelines made available to the land managing agencies.

3. To advise industry and the public of the importance of fish habitat and the methods needed to protect this habitat during land use activities.

TECHNIQUES USED

Statistical Design

Assessment of Rearing Salmonids:

The sampling techniques used during the current study were developed to provide quantitative measurements of five parameters that are related to populations of rearing salmonids in small streams. These parameters are as follows: (1) mean catch per unit-effort, (2) species composition, (3) numerical

estimates, (4) density estimates, and (5) mean lengths. The mean catch per unit-effort, numerical estimates, and density estimates are related to the abundance of rearing fish. Species composition reflects the instream community structure, and mean lengths may reflect relationships between a population of rearing fish and the quality of the stream environment.

These parameters are quantifiable in conjunction with various collecting techniques. However, studies at Starrigavan Creek near Sitka, Alaska (see Elliott, 1978) have indicated that the use of minnow traps baited with preserved salmon eggs is the most effective and least detrimental method currently available for quantifying all of these parameters in small streams in Southeast Alaska. The following statistical design has been employed to quantify these parameters through the use of baited minnow traps.

Mean Catch Per Unit-Effort. Since most previous statistical analyses of catch per unit-effort data in fisheries research have been conducted to evaluate removal-type fisheries (see Ricker, 1975), detailed statistical analyses of catch per unit-effort data based on short term sampling of closed populations with replacement are unavailable in the literature. One aspect of catch per unit-effort that is specifically related to this study is variability of individual units of gear (i.e. minnow traps) versus the number and distribution of gear units necessary to minimize this variability. In order to evaluate this relationship the number and distribution of gear units have been standardized as much as possible and the following formula has been used to express the mean catch per unit-effort in varying field situations:

$$\overline{CPUE} = \frac{\sum \frac{M_i}{T_i}}{n}$$

Where:

M_i = total number of salmonids captured by the ith trap

T_i = total time (in minutes) that the ith trap was in the water

n = total number of samples (i.e. traps)

$\overline{CPUE}$ = mean catch per unit-effort (e.g. 1 fish/min)

This formula allows the calculation of the variance of $\overline{CPUE}$ resulting from the variability of catch per unit-effort of each unit of gear.

Species Composition. Previous studies (Elliott and Reed, 1973) have shown that species composition of rearing salmonid communities are similar to the species composition of salmonids captured in minnow traps. Although the relationships between species composition and the other parameters considered in this study have not been quantitatively

evaluated; this statistic, derived from minnow trap catches, is recorded in anticipation of future evaluation and as a qualitative index of the instream community structure. This statistic is expressed in terms of the percent of each species present in the total catch from one or more sampling periods.

Numercial Estimates. The adjusted Peterson estimate as described by Ricker (1975) has been used to estimate the numbers of rearing salmonids of a particular species in sections of small streams in Southeast Alaska. This estimation procedure requires two sampling periods. During the first period rearing fish are captured, enumerated, marked, and released. During the second period the fish are captured, enumerated, examined for marks, and released. The following formula may then be used to obtain an estimate of the total number fish in the area sampled:

$$N^* = \frac{(M+1)\ (C+1)}{R+1}$$

Where:

M = total number of marked fish released during the initial capture period

C = total number of fish captured (i.e. marked + unmarked) during the recapture period

R = total number of marked fish captured during the recapture period

N* = estimated total number of fish in the area sampled (e.g. 500 Dolly Varden in a 1,000 ft section of a stream)

Several assumptions must be met before this estimate can be considered accurate. These assumptions as well as the attachment of confidence intervals to this estimate are discussed in reference to the current study in a later section of this report.

Density Estimates. Once a reasonable estimate of the numbers of rearing fish in a section of a stream has been obtained it may be desirable to compare this estimate with a similar estimate from another stream. In order to make such comparisons the estimates must be related to some unit of measurement common to both streams. In the present study the surface area of the section of the stream examined was used. Because of logistical problems and varying time constraints two methods were used to obtain approximate surface areas of the stream sections studied.

The simplest and least accurate method was to pace off the length and several widths of the stream section under consideration and multiply the length times the average width. Density estimates using this approximation of the surface area are referred to as "rough density estimates" in the remainder of this report. The second method used a tape measure

to measure 15.24 m (50 ft) intervals parallel to the streambanks and to measure the width of the stream at each interval. From these measurements a series of trapezoids can be obtained and the sum of their areas will give an approximation of the surface area. The "density estimates" presented in this report include the use of this method to estimate the surface area of the stream section under consideration. The rough density estimates and density estimates recorded in this report are expressed as numbers of fish (i.e. N* as defined above) per unit area (i.e. surface area as determined by one of the two methods described above).

Mean Lengths. This statistic is derived from fork length measurements to the nearest millimeter of fish captured in minnow traps during a single trapping period.

Assessment of Aquatic Insects:

Quantitative methods for assessing communities of aquatic insects were studied by Carle (1976) and a statistical design was described which involved depletion or removal sampling techniques and a specially designed sampling device termed a circular depletion sampler (CDS). The sampling techniques involved placing the CDS into the substrate, collecting insects by agitating the substrate for one minute, removing the collected specimens from the CDS, and then repeating the process until three samples had been collected. Carle and Strub (1978) discuss the necessary assumptions and the theory leading to the development of maximum likelihood estimation of population sizes from removal data. Provided the assumptions are met the following inequality may be used to estimate the total number of individual organisms within the area encompassed by the CDS where three removal periods are used:

$$\left(\frac{\hat{N}+1}{\hat{N}-T+1}\right)\left(\frac{3\hat{N}-X-T+1}{3\hat{N}-X+2}\right)\left(\frac{3\hat{N}-X-T+2}{3\hat{N}-X+3}\right)\left(\frac{3\hat{N}-X-T+3}{3\hat{N}-X+4}\right)-1 \leq 0$$

Where:

$\hat{N}$ = the estimated number of individuals in the sample area

$T = \sum_{i=1}^{\kappa=3} C_i$ = the sum of the individuals captured during all three removal periods

$X = 2C_1 + C_2$

C_i = the number of individuals collected during the ith removal period

This inequality may be solved iteratively with a desk calculator or a computer by letting $\hat{N} = T, T+1, T+2 \ldots$ and continuing to iterate until the inequality is satisfied (i.e. when the value of the left side of the inequality is as close to 0 as possible).

Methods

Field work was carried out in three phases: (1) site selection, (2) biological assessment, and (3) physical assessment. The primary factors affecting site selection were the accessibility of the area and the size of the stream. Because the sampling procedure for examining rearing fish had been designed primarily for small streams, a general guideline for the selection of study sites was to locate a section of the stream that averaged 6 m (20 ft) or less in width and 1.2 m (4 ft) or less in depth. Occasionally limited time and/or access problems dictated the selection of larger stream sections for study. When stream sections within the preceding size range were located, beach seines were placed upstream and downstream of the study site to prevent major movements of rearing fish into or out of the area. This was impractical for larger stream sections.

Biological assessment consisted primarily of sampling populations of rearing fish, although aquatic insect samples were also collected in one area. The sampling procedure for rearing fish consisted of an initial capture period and a recapture period. During the initial capture period, minnow traps baited with preserved salmon eggs were placed at 15 m (50 ft) intervals until 18-20 traps had been set. Set times were recorded. After a minimum time period of two hours, the traps were pulled. Times were recorded and captured fish were transferred to a bucket containing stream water and a small amount of MS 222 (tricaine methane-sulfonate). Fish were then identified, enumerated, measured, marked with a caudal clip (i.e. a small notch was made in either the upper or lower lobe of the caudal fin), and then transferred to another bucket containing fresh stream water and allowed to recover. When all the fish had recovered, they were returned to the stream at the point of capture. This process was repeated until all the traps were checked.

The study section was left in an undisturbed state for at least 24 hours, and then traps were reset in the same manner and in the same locations as during the initial capture period. Procedures during the recapture period were the same as during the initial capture period, except that the number of marked fish was also recorded and no measurements were taken.

Aquatic insects were collected by using a circular depletion sampler (CDS) and techniques described by Carle (1976). The procedure involved placing the sampler into the substrate and collecting aquatic invertebrates by vigorously agitating the substrate to a depth of approximately 20 cm (8 in) for one minute. At the end of this period all loose debris and organisms were removed from the collector of the CDS and placed in separate containers to be sorted at a later time. The one minute agitation period was repeated until three samples had been collected from the same location. The organisms were separated from the debris in the field and placed in 95% ethyl alcohol and were identified and enumerated in the lab. Numbers collected, percent composition, and numerical estimates were then calculated with respect to the major taxa present.

Because of the time involved in site selection and biological assessment (two to three days), the physical assessment phase was limited to general observations of the major features of the stream and the immediate vicinity, recording weather conditions and temperatures, and measurements of the surface area of the sample sites.

Equipment

The following equipment was used to evaluate populations of rearing salmonids and aquatic insects:

1. Twenty double-ended minnow traps
2. Preserved salmon eggs
3. Two plastic buckets
4. Tricaine methanesulfonate (MS 222)
5. A 200 mm (8 in) metric ruler
6. A marking device
7. Two 6 m (20 ft) beach seine - 6.35 mm (0.25 in) mesh
8. A 15.24 m (50 ft) tape measure
9. A pocket thermometer
10. Several 500 ml (0.132 gal) plastic bottles
11. Several small vials
12. 95% ethyl alcohol
13. A timepiece
14. Flagging material
15. Circular depletion sampler (see Carle 1976)
16. Two flat pans
17. Tweezers

FINDINGS

Results

Switzer Creek (111-40-007):

Location. Lat. 58°21'45"N, long. 134°30'10"W - 8 km (5 mi) Northwest of Juneau.

Description (Reed and Armstrong, 1971)

> Switzer Creek is a relatively small stream about one mile in length (average width of 3 feet and depth of 2 1/2 feet). It drains a watershed of about 3/4 square miles and meanders across a large tidal area before emptying into Gastineau Channel. The water is clear and the current is generally moderate. The stream is crossed by the Glacier Highway just above the intertidal area. The first approximate 1/4 mile is intertidal area. The stream meanders through this area, with a gravel bottom for most parts, and large pools inter-dispersed throughout. The banks are mud with a heavy grass cover. After crossing under the highway, the stream

winds through an open meadow area for about another 1/4 mile. In this section the stream is slough-like with mud banks heavily covered with grass. The bottom is mainly silt with small areas of gravel. About 3/8 miles from the mouth, a tributary is encountered. This fork originates in a wooded area and has a barrier falls about 3/8 mile from its mouth. After winding through the meadow area, Switzer Creek enters the woods about 1/2 mile from its mouth. Just as the Creek enters the woods, a large pond about 5-8 feet deep and about 35' x 80' in size is encountered. The stream continues through the wooded area for about 1/4 mile. The creek originates in a fairly large marsh pond located in a logged area. In general, the stream is very accessible. Access status to the meadow section is limited due to private property bordering the creek. Switzer Creek has been closed to salmon fishing since 1962. A second small tributary was encountered about 1/2 mile from the mouth, but it was not surveyed.

Barriers. None on mainstream.

Species Present. Dolly Varden, cutthroat trout, coho salmon, chum salmon, cottid.

Species Composition and Abundance (Juveniles). Rearing salmonids were captured in a section of this stream within the boundaries of the logged area on three occasions--April 20, 1978, April 24, 1978, and June 29, 1978. The means for catch per unit-effort of Dolly Varden during these periods were .023 DV/min., .026 DV/min., and .025 DV/min.; and the total catches were 95 DV, 96 DV, and 140 DV, respectively. The only other species captured during these three trapping periods were one coho salmon and one cutthroat trout. The species composition derived from the total numbers of fish captured was 99.4% Dolly Varden, 0.3% coho salmon, and 0.3% cutthroat trout.

The area sampled was 289.6 m (950 ft) in length and widths were measured at 15.24 m (50 ft) intervals. The estimated surface area was 631.7 m^2 (6,800 sq ft). The estimated number of rearing Dolly Varden in this area was 353 with a 95% confidence interval from 260 to 552. An estimate of the density of Dolly Varden in this area was 0.56 DV/m^2 (.05 DV/sq ft).

A total of 96 Dolly Varden were measured during the April 24, 1978 trapping period; they had a mean length of 77.8 mm (3.06 in) with a standard deviation of 15.5 mm (0.61 in).

Jordan Creek (111-50-062):

Location. Lat. 58°21'25"N, long. 134°34'10"W - 14.5 km (9 mi) northwest of Juneau.

Description. Jordan Creek is approximately 5 km (3 mi) long and flows along the south side of the Mendenhall Valley prior to emptying into a

lagoon near the Juneau Airport on Gastineau Channel. This stream is subject to a wide range of flows with periodic flooding during rainy periods and with some portions of the stream drying up during long hot periods. However, numerous pools throughout the length of the stream provide good rearing habitat even during dry periods. Much of the upper portion of this stream flows through or is adjacent to residential lots and the lower portion flows through commercially developed property. Some rechannelization has occurred in this lower portion.

Barriers. None.

Species Present. Dolly Varden, coho salmon, cutthroat trout, rainbow trout, stickleback, cottids.

Species Composition and Abundance (Juveniles). During 1978 rearing fish were captured in a section of this stream near the end of Dudley Street about 3 km (2 mi) upstream from the mouth on five occasions--May 4, May 5, July 20, August 10, and August 11. The means for catch per unit-effort of Dolly Varden during these periods were .008 DV/min., .003 DV/min., .020 DV/min., .032 DV/min., and .030 DV/min.; and the total catches were 47 DV, 16 DV, 90 DV, 153 DV, and 127 DV, respectively. The means for catch per unit-effort of coho salmon >55 mm (2.17 in) in length were 0.110 SS/min., .058 SS/min., .037 SS/min., .054 SS/min., and .049 SS/min; and the total catches were 558 SS, 281 SS, 170 SS, 263 SS, and 208 SS, respectively. In addition 33 coho fry (i.e. $\leq$ 55 mm or 2.17 in), one rainbow trout, one cutthroat trout, 18 stickleback, and 37 cottids were captured. The species composition derived from these catches was 21.6% Dolly Varden, 75.5% coho salmon, .05% rainbow trout, .05% cutthroat trout, 1% stickleback, and 1.8% cottids.

The area sampled was 289.6 m (950 ft) in length, and widths were measured at 15.24 m (50 ft) intervals. The estimated surface area was 2,097.2 m^2 (22,575 sq ft). Estimates of the numbers of rearing Dolly Varden and coho salmon >55 mm (2.17 in) were obtained during the May and August trapping periods. The estimated numbers of Dolly Varden were 102 in May with a 95% confidence interval from 68 to 204, and 221 in August with a 95% confidence interval from 199 to 256. The estimated numbers of coho salmon were 2,074 in May with a 95% confidence interval from 1,713 to 2,543, and 606 in August with a 95% confidence interval from 531 to 726. Density estimates were .05 DV/m^2 (.005 DV/sq ft) in May, 0.11 DV/m^2 (.01 DV/sq ft) in August; 0.99 SS/m^2 (.09 SS/sq ft) in May and 0.29 SS/m^2 (.03 SS/sq ft) in August.

A total of eight Dolly Varden were measured during the May 4, 1978 trapping period; they had a mean length of 88.9 mm (3.50 in) with a standard deviation of 14.0 mm (0.55 in) 90 DV were measured during the July 20, 1978 trapping period and had a mean length of 117.5 mm (4.63 in) with a standard deviation of 19.5 mm (0.77 in) 72 DV were measured during the August 10, 1978 trapping period; they had a mean length of 119.6 mm (4.71 in) with a standard deviation of 24.0 mm (0.94 in). A total of 171 coho salmon >55 mm (2.17 in) were measured during the May 4, 1978 trapping

period and had a mean length of 84.4 mm (3.32 in) with a standard deviation of 18.1 mm (0.71 in), 168 SS >55 mm (2.17 in) were measured during the July 20, 1978 trapping period and had a mean length of 80.0 mm (3.15 in) with a standard deviation of 8.7 mm (0.34 in) and 131 SS >55 mm (2.17 in) were measured during the August 10, 1978 trapping period and had a mean length of 80.9 mm (3.19 in) with a standard deviation of 7.6 mm (0.30 in).

Montana Creek (111-50-052):

Location. Lat. 58°22'54"N, long. 134°35'47"W - 13 km (8 mi) northwest of Juneau.

Description (Reed and Armstrong, 1971):

> Montana Creek, the largest tributary to the Mendenhall River, originates in a mountain meadow area and flows approximately seven miles, draining a watershed of about 15 square miles. The upper reaches of the stream are characterized by numerous rapids and small pools. The streambed consists of small gravel to large boulders and the banks have good growth. About three miles of the stream area are easily accessible by a well defined trail running parallel to the stream and originating at the end of the Montana Creek Road. The next 2 1/2-mile section is readily accessible by the Montana Creek Road, which parallels it. This section consists of rapids and numerous deep pools. At the lower reaches of this section, the stream flows through a canyon, which provides probably good fly fishing. Leaving the canyon, it enters a swamp-like area where numerous anabranches are formed. This area has very poor accessibility due to its swamp-like characteristics and numerous blow-downs. The stream becomes slow flowing and deep. After the stream crosses the Mendenhall Loop Road it has a short section (2 1/4 miles) easily accessible to fishermen. It appears the banks have been graded; however, the land on both sides appears to be privately owned. The final 1 1/2-2 mile section flows through a very poorly accessible area. The banks are mud and overgrown with dense underbrush consisting primarily of devil's club. The stream is too deep for wading. The stream mouth is accessible for fishing by a trail starting at the Brotherhood Bridge and following the Mendenhall River. The flow of system has been estimated at 150 cfs . . .

Barriers. None.

Species Present. Dolly Varden, steelhead trout, cutthroat trout, coho salmon, chum salmon, cottids.

Species Composition and Abundance (Juveniles). Rearing fish were captured in a section of this stream upstream of the bridge crossing on the Glacier Loop Road on August 7 and 8, 1978. The means for catch per

unit-effort of Dolly Varden were .003 DV/min. and .020 DV/min., and the catches were 16 DV and 69 DV, respectively.

The means for catch per unit-effort of coho salmon >55 mm (2.17 in) were .019 SS/min. and .015 SS/min., and the catches were 95 SS and 52 SS, respectively. In addition, 61 coho fry (i.e. ≤55 mm or 2.17 in. in length) and 46 cottids were captured during the two trapping periods. Species composition as derived from these catches was 27% Dolly Varden, 60% coho salmon, and 13% cottids.

The area sampled was 304.8 m (1,000 ft) in length and widths were measured at 15.24 m (50 ft) intervals. The estimated surface area was 3,770 m^2 (40,575 sq ft). The estimated number of rearing Dolly Varden in this area was 149 with a 95% confidence interval from 85 to 397, and the estimated number of coho salmon >55 mm (2.17 in) in length in this area was 363 with a 95% confidence interval from 242 to 636. Density estimates for Dolly Varden were .04 DV/m^2 (.004 DV/sq ft), and for coho salmon were 0.10 SS/m^2 (.009 SS/sq ft).

A total of 16 Dolly Varden were measured during the August 7, 1978 trapping period; they had a mean length of 105.7 mm (4.16 in) with a standard deviation of 27.4 mm (1.08 in). A total of 94 coho salmon >55 mm (2.17 in) were also measured during this period; they had a mean length of 79.6 mm (3.13 in) with a standard deviation of 7.9 mm (0.31 in).

Peterson Creek (111-50-010):

Location. Lat. 58°29'45"N, long. 134°46'45"W - 31 km (19 mi) northwest of Juneau.

Description (Reed and Armstrong, 1979):

> Peterson Creek has its headwaters on Auke Mountain. After flowing in a northwesterly direction for approximately seven miles, it empties into Salt Lake, a salwater lagoon on Favorite Channel. Peterson Lake is the major lake on the stream. The lower reaches of the creek flow through open fields, and this creek section is slow flowing and deep. Access is restricted because of the surrounding privated land. About 3/4 mile from its mouth, the stream flows under the Glacier Highway. The stream enters the trees about one mile upstream and widens out (to about 12 feet) and becomes shallow (about one food deep). For about the next 1/4 mile, it consists of riffle areas with fine to medium gravel cover. The bank cover is good, however, it does not impede accessibility. Following the riffle section, the stream enters a canyon headed by a falls. The only area of difficult accessibility is the canyon. Six small to medium tributaries were encountered but none were surveyed. Peterson Creek was named for John G. Peterson, a Juneau businessman and miner . . .

Barriers. Total fish block approximately 2 1/2 km (1 1/2 mi) upstream from the mouth in the form of a 15 m (50 ft) falls.

Species Present. Dolly Varden, steelhead trout, cutthroat trout, coho salmon, chum salmon, pink salmon, stickleback, and cottids.

Species Composition and Abundance (Juveniles). Rearing fish were captured in a section of this stream in the vicinity of the Glacier Highway bridge on August 2 and 3, 1978. The means for catch per unit-effort of Dolly Varden were .0006 DV/min. and .0008 DV/min.; and the catches were 3 DV and 3 DV, respectively. The means for catch per unit-effort of coho salmon >55 mm (2.17 in) in length were .019 SS/min. and .029 SS/min.; and the catches were 96 SS and 107 SS, respectively. The means for catch per unit-effort of rainbow trout (probably rearing steelhead trout) were .002 RT/min. and .004 RT/min.; and the catches were 11 RT and 13 RT, respectively. In addition, 528 coho fry (i.e. <55 mm or 2.17 in), one stickleback, and 25 cottids were captured. Species composition as derived from these catches was 0.8% Dolly Varden, 92.9% coho salmon, 3% rainbow trout, 3.2% cottids, and 0.1% stickleback.

The area sampled was 304.8 m (1,000 ft) in length and widths were measured at 15.24 m (50 ft) intervals. The estimated surface area was 3,233 m^2 (34,800 sq ft). The estimated numbers of rearing coho salmon (>55 mm or 2.17 in. in length) in this area was 476 with a 95% confidence interval from 338 to 748. Because of low recapture rates no other estimates were obtained. The density estimate for coho salmon was 0.15 SS/m^2 (.01 SS/sq ft).

A total of 91 coho salmon >55 mm (2.17 in) were measured during the August 2, 1978 trapping period and had a mean length of 79.9 mm (3.15 in) with a standard deviation of 16.0 mm (0.63 in).

North Hood Bay, unnamed stream (112-72-005):

Location. Lat. 57°23'36"N, long. 134°21'36"W - 1.6 km (1 mi) from the head of North Hood Bay on the north side of the bay on the west coast of Admiralty Island.

Description. This small stream is about 5 km (3 mi) long and averages 6 m (20 ft) in width and 1/2 m (1 1/2 ft) in depth. The water is clear and the current is moderate, but there was some evidence of fluctuations in flows. There was a limited amount of spawning area in the lower portion of the stream; but the remainder of the stream was characterized by the following pattern: small debris jams with associated pools, a series of shallow riffles, and another debris jam and pool. A few adult pink salmon were seen in the lower portion of the stream.

Barriers. Several partial barriers and debris jams, but no total barriers were noted in the section surveyed.

Species Present. Dolly Varden, coho salmon, pink salmon, cutthroat trout, and cottids.

Species Composition and Abundance (Juveniles). Rearing fish were captured in a section of this stream about 152 m (500 ft) upstream from the mouth on August 29 and 30, 1978. The means for catch per unit-effort of Dolly Varden were .033 DV/min. and .032 DV/min; and the catches were 167 DV and 176 DV, respectively. The means for catch per unit-effort for coho salmon >55 mm (2.17 in) in length were .006 SS/min and .007 SS/min, and the catches were 27 SS and 33 SS, respectively. In addition, 42 coho fry (i.e. ≤55 mm or 2.17 in), three cutthroat trout, and 283 cottids were captured. The species composition as derived from these catches was 46.9% Dolly Varden, 14% coho salmon, 0.4% cutthroat trout, and 38.7% cottids.

The area sampled was 304.8 m (1,000 ft) in length, and widths were measured at 15.24 m (50 ft) intervals. The estimated surface area was 1,760.5 m^2 (18,950 sq ft). The estimated number of rearing Dolly Varden in this area was 354 with a 95% confidence interval from 307 to 425. The estimated number of coho salmon >55 mm (2.17 in) in length was 136 with a 95% confidence interval from 79 to 476. Density estimates were 0.20 DV/m^2 (.019 DV/sq ft) and .08 SS/m^2 (.007 SS/sq ft).

A total of 167 Dolly Varden were measured during the August 29, 1978 trapping period. They have a mean length of 88.6 mm (3.49 in) with a standard deviation of 21.1 mm (0.83 in). A total of 27 coho salmon >55 mm (2.17 in) were also measured during this period; they had a mean length of 64.0 mm (2.52 in) and a standard deviation of 9.5 mm (0.37 in).

Big Bay - Upper Lake Inlets (113-31-003):

Location. Lat. 56°50'40"N, long. 134°17'15"W - 32 km (20 mi) South of Sitka on the west coast of Baranof Island.

Description. The Big Bay system consists of an outlet stream (113-31-003) approximately 4 1/2 km (2 3/4 mi) in length which drains into Big Bay, a shallow lower lake approximately 1 km (1/2 mi) in length and less than 1/2 km (1/4 mi) in width, an interconnecting stream approximately 1/2 km (1/4 mi) in length containing a barrier falls, the upper lake which is approximately 1 km (1/2 mi) in length and less than 1/2 km (1/4 mi) in width, and an inlet stream which is approximately 6 1/2 km (4 mi) in length with an average width of 24 m (80 ft). The water was coffee colored in the inlet stream but visibility was good to depths of about 1 1/2 m (5 ft).

Barriers. A falls extends for 24 m (80 ft) at a 30° angle between the upper and lower lakes.

Species Present. Upper lake, Dolly Varden and cutthroat trout.

Species Composition and Abundance (Juveniles). Rearing fish were captured in the main inlet (inlet 1) to the upper lake on June 20 and 21, 1978, and in a smaller inlet stream (inlet 2) on June 22 and 23, 1978. The means for catch per unit-effort on the main inlet for Dolly Varden were .016 DV/min. and .017 DV/min. and on the smaller inlet were .017 DV/min.

and .020 DV/min. The catches of Dolly Varden were 84 and 76 on the main inlet and 67 and 68 on the smaller inlet. The means for catch per unit-effort of cutthroat trout were .006 CT/min. and .003 CT/min. on the main inlet, and .008 CT/min. and .005 CT/min. on the smaller inlet. The catches of cutthroat trout were 30 and 11 on the main inlet and 30 and 18 on the smaller inlet. The species composition derived from these catches was 80% Dolly Varden and 20% cutthroat trout in the main inlet and 74% Dolly Varden and 26% cutthroat trout in the smaller inlet.

The area trapped on the main inlet was 800 m (2,625 ft) in length with an average width of 21.3 m (70 ft). A rough estimate of the surface area of this section (i.e. length x average width) was 17,070 m^2 (183,750 sq ft). The estimated number of Dolly Varden in this section was 595 with a 95% confidence interval from 364 to 1,309. The rough density estimate was .03 DV/m^2 (.003 DV/sq ft). No marked cutthroat trout were trapped during the recapture period, and an estimate of their numbers was not obtained.

The area trapped in the smaller inlet was 304.8 m (1,000 ft) in length with an average width of 1.524 m (5 ft). A rough estimate of the surface area of this section (i.e. length x average width) was 465 m^2 (5,000 sq ft). The estimated number of Dolly Varden in this section was 151 with a 95% confidence interval from 120 to 213. The rough density estimate was 0.32 DV/m^2 (.03 DV/sq ft). The estimated number of cutthroat trout in this section was 98 with a 95% confidence interval from 54 to 295. The rough density estimate was 0.21 CT/m^2 (.02 CT/sq ft).

During the June 20, 1978 trapping period on the main inlet, 84 Dolly Varden were measured. They had a mean length of 81.7 mm (3.22 in) with a standard deviation of 22.5 mm (0.89 in); and 30 cutthroat trout were measured and had a mean length of 88.0 mm (3.46 in) with a standard deviation of 23.3 mm (0.92 in). During the June 22, 1978 trapping period on the smaller inlet, 66 Dolly Varden were measured and had a mean length of 81.8 mm (3.22 in) with a standard deviation of 18.0 mm (0.71 in), and 30 cutthrout trout were measured and had a mean length of 91.7 mm (3.61 in) with a standard deviation of 12.2 mm (0.48 in).

Olive Cove (unnamed stream):

Location. Lat. 56°10'45'N, long. 132°19'30"W - 40 km (25 mi) south of Wrangell on the east coast of Etolin Island.

Description. This stream is approximately 4 km (2 1/2 mi) in length and drains into Olive Cove less than 1/2 km (1/4 mi) from the mouth of Snake Creek (107-30-070). The water is clear, the average width is 9 m (30 ft), and pools over 1 m (4 ft) in depth occur periodically.

Barriers. A partial barrier is located about 1 km (1/2 mi) upstream from the mouth.

Species Present. Dolly Varden, coho salmon, and pink salmon.

Species Composition and Abundance. Rearing fish were captured in a section of this stream approximately 1 1/2 km (1 mi) upstream from the mouth on July 6 and 7, 1978. The only species captured were Dolly Varden. The means for catch per unit-effort were .044 DV/min. and .079 DV/min.; and the catches were 223 and 275, respectively.

The area sampled was 304.8 m (1,000 ft) in length and widths were measured at 15.24 m (50 ft) intervals. The estimated surface area was 2,094.9 m^2 (22,550 sq ft). The estimated number of rearing Dolly Varden in this area was 695 with a 95% confidence interval from 594 to 847. The estimated density in this area was 0.33 DV/m^2 (.03 DV/sq ft).

A total of 223 Dolly Varden were measured during the July 6, 1978 trapping period and had a mean length of 96.0 mm (3.78 in) with a standard deviation of 14.8 mm (0.58 in).

Luck Lake, Eagle Creek (106-10-030):

Location. Lat. 55°57'42"N, long. 132°43'13"W - approximately 80 km (50 mi) southwest of Wrangell on the east coast of Prince of Wales Island.

Description. This system consists of Eagle Creek, which is the outlet stream of Luck Lake; Luck Lake; and Luck Creek, the major inlet to Luck Lake. Eagle Creek is approximately 3 km (1 3/4 mi) long and 24 m (80 ft) wide. Luck Lake is approximately 3 km (2 mi) in length and averages 1/2 km (1/4 mi) in width. Luck Creek and its associated tributaries are nearly 32 km (20 mi) in length and the mainstream averages 15 m (50 ft) in width. This watershed was roaded and logged in the early 1970's and large portions of the system were affected by these activities.

Barriers. There is a falls on Luck Creek about 1 1/2 km (1 mi) above the lake. The major drop is about 1 m (4 ft) in height and is followed by a series of shallow drops. It is not a total barrier to fish passage. A fish ladder was installed by the U.S. Forest Service in the early 1970's but was subsequently washed out. An additional set of falls is located about 2 1/2 km (1 1/2 mi) above the lake on Luck Creek and it consists of two drops about 1 m (4 ft) in height. Rearing coho salmon were captured upstream of these falls.

Species Present. Dolly Varden, steelhead trout, cutthroat trout, coho salmon, red salmon, pink salmon, chum salmon.

Species Composition and Abundance. Rearing fish were captured in two sections of the Luck Creek drainage system on June 13, 14, 15, 1978. A section of the Luck Creek mainstream approximately 3 km (2 mi) above Luck Lake was trapped on two occasions--June 13 and 14, 1978; and a section of a tributary to Luck Creek below the first falls and 1 1/2 km (1 mi) above the lake was trapped on June 14 and 15, 1978.

During the mainstream trapping periods the means for catch per unit-effort of Dolly Varden were .032 DV/min. and .023 DV/min., and the

catches were 197 DV and 73 DV. The means for catch per unit-effort of coho salmon were .022 SS/min. and .021 SS/min., and the catches were 130 SS and 67 SS. The means for catch per unit-effort of rainbow and cutthroat trout combined were .010 RT + CT/min. and .003 RT + CT/min., and the catches were 61 RT + CT and 10 RT + CT. The species composition as derived from these catches was 50% Dolly Varden, 37% coho salmon and 13% rainbow and cutthroat trout combined.

The area sampled on the mainstream was approximately 411.5 m (1,350 ft) in length and had an average width of 15.24 m (50 ft). A rough estimate of the surface area (i.e. length x average width) was 6,271 m^2 (67,500 sq ft). The estimated number of rearing Dolly Varden in this area was 729 with a 95% confidence interval from 521 to 1,121, and a rough density estimate was 0.12 DV/m^2 (.01 DV/sq ft). The estimated number of rearing coho salmon was 491 with a 95% confidence interval from 340 to 804, and a rough density estimate was .08 SS/m^2 (.01 SS/sq ft). The recapture of marked rainbow and cutthroat trout was too small to obtain an estimate of their numbers.

During the June 13, 1978 trapping period on the mainstream, 196 Dolly Varden were measured and had a mean length of 75.9 mm (2.99 in) with a standard deviation of 16.0 mm (0.63 in), 130 coho salmon were measured and had a mean length of 69.4 mm (2.73 in) with a standard deviation of 7.4 mm (0.29 in), and 61 rainbow and cutthroat trout were measured and had a mean length of 77.4 mm (3.05 in) with a standard deviation of 21.5 mm (0.85 in).

During the tributary trapping periods the means for catch per unit-effort for Dolly Varden were .022 DV/min. and .033 DV/min., and the catches were 95 DV and 69 DV. The means for catch per unit-effort of coho salmon were .013 SS/min. and .011 SS/min., and the catches were 54 SS and 43 SS. The means for catch per unit-effort of rainbow and cutthroat trout combined were .005 RT + CT/min. and .002 RT + CT/min., and the catches were 20 RT + CT and 7 RT + CT. The species composition in the tributary as derived from these catches was 57% Dolly Varden, 34% coho salmon, and 9% rainbow and cutthroat trout combined.

The areas sampled on the tributary was approximately 365.8 m (1,200 ft) in length and the average width was 3.05 m (10 ft). A rough estimate of the surface area was 1,115 m^2 (12,000 sq ft). The estimated number of rearing Dolly Varden in this area was 448 with a 95% confidence interval from 305 to 840, and a rough density estimate was 0.40 DV/m^2 (.04 DV/sq ft). The estimated number of coho salmon in this area was 202 with a 95% confidence interval from 127 to 346, and a rough density estimate was 0.18 SS/m^2 (.02 SS/sq ft). The recapture of marked rainbow and cutthroat trout combined was insufficient to obtain an accurate estimate of their numbers.

During the June 14, 1978 trapping period on the tributary, 94 Dolly Varden were measured and had a mean length of 69.8 mm (2 3/4 in) with a standard deviation of 12.8 mm (0.5 in); 54 coho salmon were measured and

had a mean length of 69.1 mm (2.72 in) with a standard deviation of 9.1 mm (0.36 in); and 20 rainbow and cutthroat were measured and had a mean length of 82.1 mm (3.23 in) with a standard deviation of 16.7 mm (0.66 in).

Aquatic Insects, Species Composition and Abundance. Aquatic insects were collected in the mainstream of Luck Creek on June 15, 1978. Nineteen taxa were collected and the numbers collected, percent composition, and density estimates are presented in Table 2.

Red Lake Inlet (106-41-030):

Location. Lat. 56°15'46"N, long. 133°19'50"W - approximately 80 km (50 mi) southwest of Petersburg on the north coast of Prince of Wales Island.

Description. The Red Lake watershed includes the outlet stream which drains into Red Bay, Red Lake, and the inlet stream. The outlet stream is less than 1 1/2 km (1 mi) in length from the lake to the intertidal area and averages 30 m (100 ft) in width. It is also fed by a tributary that is approximately 7 km (4 1/2 mi) in length. Red Lake is over 3 km (2 mi) in length and about 1/2 km (1/4 mi) in width. The main inlet is over 3 km (2 mi) in length with an average width of 4 m (13 ft). There has been some logging and roadbuilding activity in the area, but the only known activity directly affecting the watershed is a bridge crossing site on the outlet stream near the intertidal area.

Species Present. Dolly Varden, steelhead trout, rainbow trout, cutthroat trout, coho salmon, red salmon, pink salmon, chum salmon, stickleback, and cottids.

Species Composition and Abundance. Rearing fish were captured on a section of the main inlet stream on July 11 and 12, 1978. The means for catch per unit-effort of Dolly Varden were .018 DV/min. and .023 DV/min., and the catches were 108 DV and 104 DV. The means for catch per unit-effort of coho salmon were .033 SS/min. and .045 SS/min., and the catches were 179 SS and 192 SS. Approximately 21% of these rearing coho were <55 mm (2.17 in) and the adjusted means for catch per unit-effort excluding these fish were approximately .025 SS/min. and .035 SS/min. The means for catch per unit-effort of rainbow trout were .008 RT/min. and .006 RT/min., and the catches were 52 RT and 27 RT. In addition three cutthroat trout, 18 stickleback, and nine cottids were captured during the two periods. The species composition as derived from these catches was 30.6% Dolly Varden, 53.6% coho salmon, 11.4% rainbow trout, 0.4% cutthroat trout, 2.6% stickleback, and 1.3% cottids.

The area sampled was 274.3 m (900 ft) in length and widths were measured at 15.24 m (50 ft) intervals. Thus, an estimate of the surface area was 1,135.7 m^2 (12,225 sq ft). An estimate of the numbers of Dolly Varden in this area was 369 with a 95% confidence interval from 286 to 545, and a density estimate was 0.32 DV/m^2 (.03 DV/sq ft). An estimate of the numbers of coho salmon was 620 with a 95% confidence interval

Table 2. Data from circular depletion sampling of aquatic insects in Luck Creek (June 15, 1978).

TAXA	NUMBER COLLECTED	PERCENT COMPOSITION	NUMERICAL ESTIMATE
Alloperla sp.	70	30.4	72
Baetis parvus	62	28.3	66
Baetis bicaudatus	3		
Chironomidae (larvae)	27	11.7	29
Cinygmula sp.	26	11.3	27
Ephemerella tibialis	21	10.4	24
Ephemerella doddsi	3		
Epeorus grandis	3	2.6	...
Epeorus albertae	1		
Epeorus sp.	2		
Dicranota sp.	4	1.7	...
Rithrogena grandis	1	0.4	...
Ameletus sp.	1	0.4	...
Paraleptophlebia sp.	1	0.4	...
Leuctra sp.	1	0.4	...
Rhyacophila sp.	1	0.4	...
Limnephilidae	1	0.4	...
Roederoides sp.	1	0.4	...
Glossosoma sp.	1	0.4	...
TOTAL	230		

from 503 to 790 and a density estimate was 0.55 SS/m^2 (.05 SS/sq ft). An estimate of the numbers of rainbow trout was 212 with a 95% confidence interval from 124 to 495 and a density estimate was 0.19 RT/m^2 (.01 RT/sq ft).

A total of 108 Dolly Varden were measured during the July 11, 1978 trapping period and the mean length was 86.3 mm (3.40 in) with a standard deviation of 18.8 mm (0.74 in); 174 coho salmon were measured and had a mean length of 78.8 mm (3.10 in) with a standard deviation of 22.0 mm (0.87 in). Excluding 42 of these coho which were ≤55 mm (2.17 in) in length gives a mean of 88.4 mm (3.48 in) with a standard deviation of 15.9 mm (0.63 in). Also 52 rainbow trout were measured and had a mean length of 90.1 mm (3.55 in) with a standard deviation of 20.3 mm (0.80 in).

Flicker Creek (106-41-045):

Location. Lat. 56°20'20"N, long. 133°32'00"W - approximately 80 km (50 mi) southwest of Petersburg on the north end of Prince of Wales Island between Exchange Cove and Red Bay.

Description. Flicker Creek is nearly 10 km (6 mi) in length and approximately 15 km (50 ft) wide. It joins Alder Creek (106-41-044) at the intertidal area. There has been some recent logging and roading activities in the area, but detailed surveys of this stream have not been conducted.

Species Present. Dolly Varden, coho salmon, rainbow trout, cottids.

Species Composition and Abundance. Rearing fish were captured on July 31, 1978 in a 304.8 m (1,000 ft) section of the mainstream approximately 1 1/2 km (1 mi) upstream from the mouth and about 1/2 km (1/4 mi) upstream from a bridge crossing site. The means for catch per unit-effort recorded during this trapping period were .026 DV/min. for Dolly Varden and .015 SS/min. for coho salmon >55 mm (2.17 in) in length. The total number of fish captured was 116 Dolly Varden, 157 coho salmon, 2 rainbow trout and one cottid. The species composition derived from these catches was 42% Dolly Varden, 56.9% coho salmon, 0.7% rainbow trout, and 0.4% cottids.

A total of 116 Dolly Varden were measured and had a mean length of 77.9 mm (3.07 in) with a standard deviation of 12.0 mm (0.47 in). Also 88 coho salmon fry (i.e. ≤55 mm or 2.17 in) were captured. A total of 69 coho salmon >55 mm (2.17 in) were measured and had a mean length of 83.4 mm (3.28 in) with a standard deviation of 6.5 mm (0.26 in).

Population numbers were not estimated.

Keta River (101-30-030):

Location. Lat. 55°20'10"N, long. 130°28'29"W - approximately 97 km (60 mi) east of Ketchikan.

Description. The Keta River is the mainstream of a fairly large watershed that drains into Boca de Quadra approximately 97 km (60 mi) east of Ketchikan. The main river is over 22 1/2 km (14 mi) long and frequently exceeds 30 m (100 ft) in width. There are a few braided areas, but side sloughs less than 15 m (50 ft) in width and frequently over 305 m (1,000 ft) in length occur at intervals along the mainstream. Studies were begun in the summer of 1977 to assess the possible impacts of a proposed molybdenum mine site and related construction activities in the area. A report on these studies will be published in the future, and a summary of activities to date is beyond the scope of this report.

Species Present. Pink salmon, chum salmon, coho salmon, king salmon, red salmon, steelhead trout, rainbow trout, and Dolly Varden.

Species Composition and Abundance. Rearing fish were captured in three sloughs of the Keta River within a 1 1/2 km (1 mi) radius of Hill Creek--a major tributary located approximately 11 km (7 mi) from the mouth of the river. For purposes of identification, these areas have been named Cabin Slough, Hill Creek Slough, and Logjam Slough. Cabin Slough is an anabranch of the Keta River approximately 457 m (1,500 ft) in length and averaging 15 m (50 ft) in width. This slough is located approximately 1/2 km (1/4 mi) upstream of the confluence of Hill Creek and the Keta River. Because of the width of this slough the sampling procedure was modified so that 20 minnow traps were set at 7 1/2-m (25-ft) intervals with each trap set on alternate sides of this slough. In this manner a 152 m (500 ft) section of this slough was sampled on October 20 and 21, 1978.

The means for catch per unit-effort of Dolly Varden were .008 DV/min. and .010 DV/min., the means for catch per unit-effort of coho salmon (>55 mm or 2.17 in. in length) were .027 SS/min. and .028 SS/min., and the means for catch per unit-effort of chinook salmon were .003 KS/min. and .005 KS/min. Totals of 35 and 39 Dolly Varden, 119 and 109 coho salmon >55 mm (2.17 in), and 16 and 22 chinook salmon, respectively, were captured during the two sampling periods. In addition, 230 and 176 coho salmon fry (i.e. $\leq$55 mm or 2.17 in) were captured. Species composition derived from these catches was 10% Dolly Varden, 85% coho salmon, and 5% chinook salmon.

The area sampled was 152.4 m (500 ft) in length and averaged 15 m (50 ft) in width. A rough estimate of the surface area (i.e. length x average width) was 2,323 m^2 (25,000 sq ft). The estimated number of coho salmon >55 mm (2.17 in) was 825 with a 95% confidence interval from 550 to 1,467, and a rough density estimate was 0.36 SS/m2 (.03 SS/sq ft). Because of the low numbers of recaptured, marked Dolly Varden and chinook salmon, reasonable estimates of their numbers could not be obtained.

Hill Creek slough is a branch of Hill Creek that enters the Keta River below the main confluence of Hill Creek and the Keta River. Rearing fish were captured on a 304.8 m (1,000 ft) section of this slough on August 16 and 17, 1978 and October 24, 1978. The means for catch per

unit-effort of Dolly Varden were .058 DV/min., .047 DV/min., .076 DV/min.; and the means for catch per unit-effort of coho salmon >55 mm (2.17 in) were .042 SS/min., .051 SS/min., and 0.151 SS/min., respectively. The total catches during these periods were 259, 173, and 247 Dolly Varden; 199, 202, and 512 coho salmon >55 mm mm (2.17 in); and 254, 487, and 536 coho salmon fry (i.e. ≤55 mm or 2.17 in); respectively. In addition a total of 49 chinook salmon and 17 cottids were captured during the three periods. Species composition as derived from these catches was 23.1% Dolly Varden, 74.6% coho salmon, 1.7% chinook salmon and 0.6% cottids.

The area sampled was 304.8 m (1,000 ft) in length, and widths were measured at 15.24-m (50-ft) intervals. The estimated surface area of the section sampled was 2,965.8 m^2 (31,925 sq ft). Estimates of numbers of fish were obtained during the August sampling periods only. The estimated number of Dolly Varden was 1,131 with a 95% confidence interval from 870 to 1,560. An approximate density estimate for Dolly Varden was 0.38 DV/m^2 (.04 DV/sq ft). The estimated number of coho salmon >55 mm (2.17 in) in length was 1,081 with a 95% confidence interval from 833 to 1,538. An approximate density estimate for coho salmon was 0.36 SS/m^2 (.03 SS/sq ft).

During the August 16, 1978 trapping period, 259 Dolly Varden were measured and had a mean length of 86.6 mm (3.41 in) with a standard deviation of 17.3 mm (0.68 in); and 198 coho salmon >55 mm (2.17 in) were measured and had a mean length of 75.2 mm (2.96 in) with a standard deviation of 11.6 mm (0.46 in). During the October 24, 1978 trapping period, 142 Dolly Varden were measured and had a mean length of 61.4 mm (2.42 in) with a standard deviation of 12.5 mm (0.49 in); 252 coho salmon >55 mm (2.17 in) were measured and had a mean length of 62.3 mm (2.45 in) with a standard deviation of 6.4 mm (0.25 in); and 31 chinook salmon were measured and had a mean length of 70.6 mm (2.78 in) with a standard deviation of 5.4 mm (0.21 in).

Logjam Slough is an anabranch of the Keta River about 1/2 km (1/4 mi) downstream from the confluence of Hill Creek and the Keta River. Rearing fish were captured in a section of this slough on August 18 and 19, 1978. The means for catch per unit-effort of Dolly Varden were .004 DV/min. and .009 DV/min., and the catches were 18 and 34, respectively. The means for catch per unit-effort of coho salmon >55 mm (2.17 in) were .021 SS/min and .019 SS/min., and the catches were 85 and 72, respectively. In addition a total of 901 coho salmon fry ≤55 mm (2.17 in) and one cottid were captured during this trapping period. The species composition, as derived from these catches, was 4.7% Dolly Varden, 95.2% coho salmon, and 0.1% cottids.

The area sampled was 304.8 m (1,000 ft) in length and the average width was 12.19 m (40 ft). A rough estimate of the surface area (i.e. length x average width) was 3,716 m^2 (40,000 sq ft). The estimated numbers of coho salmon >55 mm (2.17 in) in this section was 785 with a 95% confidence interval from 448 to 2,093. The rough density estimate was 0.21 SS/m^2 (.02 SS/sq ft). An insufficient number of marked Dolly Varden were recaptured so an estimate of their numbers was not obtained.

During the August 18, 1978 trapping period, 18 Dolly Varden were measured and found to have a mean length of 75.0 mm (2.95 in) with a standard deviation of 24.1 mm (0.95 in) and 85 coho salmon >55 mm (2.17 in) were measured and found to have a mean length of 66.2 mm (2.61 in) with a standard deviation of 8.6 mm (0.34 in).

Discussion

The reason for studying different watersheds throughout Southeast Alaska was to determine if the sampling technique would yield reliable results in varying habitats and field conditions and to determine the limits of its applicability. In general the results are very encouraging. Quantitative values for the five parameters were obtained at all of the areas studied. The range of values for each of the five parameters with respect to Dolly Varden and coho salmon are presented in Table 3 and specific values from each study area are recorded in Tables I-IV in the Appendix.

Several factors must be considered in the interpretation of the values of the five parameters considered. Some of these are inherent in the sampling technique and others are the result of natural variations relating to the environment and community interactions. One factor affected both by the sample design and by natural variations was the size of the rearing fish that were sampled.

The size range of the two major species sampled by the minnow traps were from 48 mm (1.89 in) to 205 mm (8.07 in) for Dolly Varden and from 43 mm (1.69 in) to 132 mm (5.20 in) for coho salmon. In general these sizes coincide with several age classes that represent the major portion of the rearing fish population. Dolly Varden come into the catchable size range during the second season in fresh water, or as one-year-old fish. Heiser (1966) gives a size range from 21 mm (0.83 in) to 44 mm (1.73 in) with a mean of 31.4 mm (1.24 in) for zero-aged (i.e. young-of-the-year) Dolly Varden in Eva Creek on the east coast of Baranof Island. Thus zero-aged Dolly Varden are not included in data obtained through the use of minnow traps. Heiser's study also indicated that Dolly Varden usually migrate to sea during their third or fourth year of life, so the assumption was made that Dolly Varden sampled by minnow traps fell into age groups I, II, III and IV. Whether or not this assumption holds for resident populations of Dolly Varden in streams has not been determined.

A study by Crone (1968) indicated that coho salmon come into the catchable size range during their first year of life, or as zero-aged coho fry. This was apparent during the current study, since large numbers of coho salmon from 45 mm (1.77 in) to 50 mm (1.97 in) appeared in the minnow trap catches in mid-July. In order to eliminate most of the zero-aged coho from the sample data, coho salmon $\leq$55 mm (2.17 in) in length were recorded separately and were not included in the calculation of any of the five parameters covered in this report. According to Crone's data

Table 3. Ranges of values of five population parameters in eleven watersheds in Southeast Alaska with respect to rearing Dolly Varden and coho salmon (>55 mm or 2.17 in).

Parameter	RANGES	
	Dolly Varden	Coho Salmon
Mean Catch Per Unit-Effort (Number of fish per minute)	0.003 - 0.079	0.006 - 0.151
Species Composition (%)	0.8 - 100	0.3 - 95.2
Numerical Estimates (Number of fish)	102 - 1,131	136 - 2,074
Density Estimates* (Number of fish/m^2)	0.03 - 0.56	0.08 - 0.99
Mean Lengths (mm)	56.6 - 119.6	59.9 - 88.4

* Includes "rough density estimates" and "density estimates" as described in the Techniques Used section.

from Sashin Creek on Baranof Island the 55 mm (2.17 in) length effectively separates most zero-aged coho from one-year-old coho until the fall period, but from September on there was considerable overlap in the lengths of zero-aged and one-year-old coho salmon. This overlap in the fall months is probably one of the reasons that low mean lengths for coho salmon (i.e. <67 mm or 2.64 in) were recorded from the Keta River study areas in October.

An advantage of eliminating zero-aged fish from the parameters evaluated in this report is that it reduces some of the variability in the measurements that would result from the inclusion of the relatively large numbers of zero-aged fish which are present in the stream during the summer months. Since one of the main reasons for developing a short-term survey technique was to obtain reliable information that was closely related to the productivity of a stream, the exclusion of the highly variable data associated with zero-aged fish was justified and focused the efforts of the survey on the most stable portion of the rearing fish populations. The concept that one- and two-year-old coho salmon numbers represent a fairly stable portion of the population is supported by Crone's (1968) study in which the numbers of returning adult cohos and the numbers of coho fry varied considerably from year to year, while the numbers of one and two-year-old fingerlings and the numbers of emigrating coho smolt were relatively stable from year to year. Also, a study by Chapman (1962) indicates that numbers of coho fry occurring in a stream during the spring, summer and fall periods may vary considerably because of downstream migration. The previous comments regarding the 55 mm (2.17 in) length as a reasonable dividing line between zero-aged and one-year-old coho are also supported by growth curves presented by Chapman.

The current study has assumed, therefore, that the data obtained from the use of minnow traps was representative of the most stable portion of the population of rearing fish and reflects the biological productivity of the stream.

Since one of the major components of the sampling techniques involved the use of the Peterson method for estimating numbers of fish within the study area, an understanding of the underlying assumptions necessary for the application of the formula for calculating the adjusted Peterson estimate was required. Ricker (1975) indicated that the following conditions should be satisfied:

1. The marked fish suffer the same natural mortality as the unmarked.

2. The marked fish are as vulnerable to the fishing being carried on as are the unmarked ones.

3. The marked fish do not lose their mark.

4. The marked fish become randomly mixed with the unmarked; or the distribution of fishing effort (in subsequent sampling) is proportional to the number of fish present in different parts of the body of water.

5. All marks are recognized and reported on recovery.

6. There is a negligible amount of recruitment to the catchable population during the time the recoveries are being made.

In terms of the sampling techniques employed during the current study differential effects of natural mortality with respect to marked and unmarked fish were presumed to be negligible. The brief duration of the capture-recapture periods (i.e. two days), efforts to ensure that marked fish fully recovered from the anesthetic before being returned to the stream, and exclusion of zero-aged fish from the calculations helped to minimize possible effects of differential mortality.

The use of a caudal notch as a mark was felt to have little effect on the vulnerability of fish to capture. The mark was temporary and became completely obscured by regenerative growth after a month or two. A factor having greater effect on the catchability of fish during the recapture period is the amount of salmon eggs used during the initial capture period. If too many eggs are used some of the fish may become satiated during the initial capture period and will be less inclined to enter the minnow traps a second time. To avoid this problem the bait size used during the initial capture period was limited to skein sections less than 38 mm (1 1/2 in) in diameter, and a period of 24 hours was allowed to elapse between the initial capture period and the recapture period.

Because of the short time duration between trapping periods, loss of marks was not a problem.

The fourth condition listed by Ricker is the most difficult requirement to be tested and more rigorous examination will be applied to this problem during future studies. It was assumed that the application of a measured sampling design (i.e. the placement of traps at 15.24 m or 50 ft. intervals) to the presumably random distribution of rearing habitat within a stream produced a random sample of the population of rearing fish. Conclusive statistical evidence for this assumption was not obtained, however. An effort was made to maximize the degree of mixing by returning marked fish to the same area from which they were taken.

Since the caudal notch was easily recognized, little if any error occurred because of failure to record marked fish.

The sixth condition presented little source of error in terms of the present study because of the relatively instantaneous nature of the estimate, because the sample sites were usually blocked off during the trapping periods, and because of the exclusion of zero-aged fish. Recruitment could become a problem, however, if repeated estimates were to be made in a stream over a long period of time.

One of the best indicators of the validity of the Peterson estimates was the variation expressed by the calculation of the 95% confidence intervals. These were determined by following the guidelines outlined by Seber (1973 pgs 62-64). Since most of the values associated with the calculation of the Peterson estimates obtained during the current study indicated that the binomial distribution was most appropriate for the approximation of confidence intervals, all of the confidence intervals presented were obtained by calculating the two values of R (number of marked fish captured during the second trapping period) that established the limits of 95% of the area under the binomial curve and then substituting these values of R in the equation for the adjusted Peterson estimate to obtain the 95% confidence interval. Examination of the numerical estimates and their confidence intervals obtained during the current study indicated that, in general, differences between population levels were not detectable using the statistical methods and the sampling techniques described in this report unless one population estimate was at least twice the size of the other. This generalization is made with respect to the wide range of streams and habitats that were included in the current study. Smaller differences should be detectable if comparisons are made between similar streams with similar habitats during the same time period.

Several attempts were made to correlate the population estimates with the other parameters measured. There were no statistically significant linear correlations between the numerical estimates and species composition, surface area, or mean lengths. This was not surprising since each of these parameters were affected by a variety of factors associated with each stream, its ecology, and environment; and no attempt was made to equalize or evaluate all of these effects.

One potentially useful correlation did emerge from this study, however, and that was the relationships between numerical estimates and mean catch per unit effort. It must be emphasized that this relationship is very tentative in terms of the data that is currently available and that extensive field testing and detailed statistical analysis will be required before any definite conclusion can be made.

However, with the relatively small sample sizes in the current study (i.e. n=10 for Dolly Varden and n=11 for coho salmon) correlation of mean catch per unit-effort and the Peterson estimates yielded coefficients of determination (i.e., r^2 values) of 0.75 and 0.84, respectively. Although detailed analysis of this relationship must await further study, these values point to a linear relationship between the two parameters. If future studies substantiate this relationship, then a statistical model could be developed which would enable the fisheries biologist to estimate numbers of rearing fish from catch per unit-effort data. The pratical benefits of such a model would be a substantial reduction (at least 1/2) of the time and labor currently required to estimate the numbers of rearing fish in streams in Southeast Alaska.

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APPENDIX

Table I. Mean catch per unit-effort ($\overline{CPUE}$) from minnow trapping data, 1978

Study Area	Date	$\overline{CPUE}$ FOR EACH SPECIES (no. fish/min) DV	SS	CT	RT
Switzer Creek	April 20	0.023	...	...	...
	April 24	0.026	...	...	...
	June 29	0.025	...	...	...
Jordan Creek	May 4	0.008	0.110	...	...
	May 5	0.003	0.058	...	...
	July 20	0.020	0.037	...	...
	Aug. 10	0.032	0.054	...	...
	Aug. 11	0.030	0.049	...	...
Montana Creek	Aug. 7	0.003	0.019	...	...
	Aug. 8	0.020	0.015	...	...
Peterson Creek	Aug. 2	0.001	0.019	...	0.002
	Aug. 3	0.001	0.029	...	0.004
North Hood Bay	Aug. 29	0.033	0.006	...	...
	Aug. 30	0.032	0.007	...	...
Big Bay Inlet #1	June 20	0.016	...	0.006	...
	June 21	0.017	...	0.003	...
Big Bay Inlet #2	June 22	0.017	...	0.008	...
	June 23	0.020	...	0.005	...
Olive Cove	July 6	0.044	...	...	...
	July 7	0.079	...	...	...
				C.T. & R.T. COMBINED	
Luck Creek	June 13	0.032	0.022	0.010	
	June 14	0.023	0.021	0.003	
Luck Creek Tributary	June 14	0.022	0.013	0.005	
	June 15	0.033	0.011	0.002	
				C.T.	R.T.
Red Lake Inlet	July 11	0.018	0.025	...	0.008
	July 12	0.023	0.035	...	0.006
Flicker Creek	July 13	0.026	0.015	...	...
Hill Creek Slough	Aug. 16	0.058	0.042	...	...
	Aug. 17	0.047	0.051	...	...
	Oct. 24	0.076	0.151	...	...
Logjam Slough	Aug. 18	0.004	0.021	...	...
	Aug. 19	0.009	0.019	...	...
				K.S.	
Cabin Slough	Oct. 20	0.008	0.027	0.003	
	Oct. 21	0.010	0.028	0.005	

* Does not include coho salmon ≤55 mm (2.17 in) in length.

Table I. Mean catch per unit-effort ($\overline{CPUE}$) from minnow trapping data, 1978

Study Area	Date	$\overline{CPUE}$ FOR EACH SPECIES (no. fish/min) DV	SS	CT	RT
Switzer Creek	April 20	0.023	...	...	...
	April 24	0.026	...	...	...
	June 29	0.025	...	...	...
Jordan Creek	May 4	0.008	0.110	...	...
	May 5	0.003	0.058	...	...
	July 20	0.020	0.037	...	...
	Aug. 10	0.032	0.054	...	...
	Aug. 11	0.030	0.049	...	...
Montana Creek	Aug. 7	0.003	0.019	...	...
	Aug. 8	0.020	0.015	...	...
Peterson Creek	Aug. 2	0.001	0.019	...	0.002
	Aug. 3	0.001	0.029	...	0.004
North Hood Bay	Aug. 29	0.033	0.006	...	...
	Aug. 30	0.032	0.007	...	...
Big Bay Inlet #1	June 20	0.016	...	0.006	...
	June 21	0.017	...	0.003	...
Big Bay Inlet #2	June 22	0.017	...	0.008	...
	June 23	0.020	...	0.005	...
Olive Cove	July 6	0.044	...	...	...
	July 7	0.079	...	...	...
				C.T. & R.T. COMBINED	
Luck Creek	June 13	0.032	0.022	0.010	
	June 14	0.023	0.021	0.003	
Luck Creek Tributary	June 14	0.022	0.013	0.005	
	June 15	0.033	0.011	0.002	
				C.T.	R.T.
Red Lake Inlet	July 11	0.018	0.025	...	0.008
	July 12	0.023	0.035	...	0.006
Flicker Creek	July 13	0.026	0.015	...	...
Hill Creek Slough	Aug. 16	0.058	0.042	...	...
	Aug. 17	0.047	0.051	...	...
	Oct. 24	0.076	0.151	...	...
Logjam Slough	Aug. 18	0.004	0.021	...	...
	Aug. 19	0.009	0.019	...	...
				K.S.	
Cabin Slough	Oct. 20	0.008	0.027	0.003	
	Oct. 21	0.010	0.028	0.005	

* Does not include coho salmon ≤55 mm (2.17 in) in length.

Table 11. Species composition from minnow trapping data.

Study Area	Percent DV	Percent SS	Percent CT	Percent RT	Percent SB	Percent SC	Percent KS
Switzer Creek	99.40	0.30	...	0.30	...	...	...
Jordan Creek	21.60	75.50	0.05	0.05	0.90	1.80	...
Montana Creek	27.00	60.00	...	...	...	13.00	...
Peterson Creek	0.80	92.90	...	3.00	0.10	3.20	...
North Hood Bay	46.90	14.00	0.40	...	...	38.70	...
Big Bay Inlet 1	80.00	...	20.00	...	...	...	...
Big Bay Inlet 2	74.00	...	26.00	...	...	...	...
Olive Cove	100.00	...	...	...	...	...	...
Luck Creek	50.00	37.00	13.00 (CT & RT)		...	...	...
Luck Creek Tributary	57.00	34.00	9.00 (CT & RT)		...	...	...
Red Lake Inlet	30.60	53.60	0.40	11.40	2.60	1.30	...
Flicker Creek	42.00	56.90	...	0.70	...	0.40	...
Hill Creek Slough	23.10	74.60	...	...	...	0.60	1.70
Logjam Slough	4.70	95.20	...	...	...	0.10	...
Cabin Slough	10.00	85.00	...	...	...	...	5.00

Note: Includes coho salmon $\leq$55 mm (2.17 in) in length.

Table III. Estimates of numbers of Dolly Varden and coho salmon with 95% confidence intervals.

Study Area	DOLLY VARDEN Estimate	DOLLY VARDEN Confidence Interval	COHO SALMON* Estimate	COHO SALMON* Confidence Interval
Switzer Creek	353	260 - 552	...	... ...
Jordan Creek (May)	102	68 - 204	2,074	1,713 - 2,543
Jordan Creek (Aug)	221	199 - 256	606	531 - 726
Montana Creek	149	85 - 397	363	242 - 636
Peterson Creek	...	... ...	476	338 - 748
North Hood Bay	354	307 - 425	136	79 - 476
Big Bay Inlet #1	595	364 - 1,309	...	... ...
Big Bay Inlet #2	151	120 - 213	...	... ...
Olive Cove	695	594 - 847	...	... ...
Luke Creek	729	521 - 1,121	491	340 - 804
Luck Lake Tributary	448	305 - 840	202	127 - 346
Red Lake Inlet	369	286 - 545	620	503 - 790
Flicker Creek	...	... ...	...	... ...
Hill Creek Slough	1,131	870 - 1,560	1,081	833 - 1,538
Logjam Slough	...	... ...	785	448 2,093
Cabin Slough	...	... ...	825	550 - 1,467

* Does not include coho salmon ≤55 mm (2.17 in) in length.

Table IV. Estimated surface areas of sample sites and density estimates of populations of rearing Dolly Varden and coho salmon.

Study	SURFACE AREA m^2	SURFACE AREA ft^2	DENSITY ESTIMATES (fish/m^2) DV	DENSITY ESTIMATES (fish/m^2) SS ***
Switzer Creek*	631.7	6,800	0.56	...
Jordan Creek (May)*	2,097.2	22,575	0.05	0.99
Jordan Creek (Aug)*	2,097.2	22,575	0.11	0.29
Montana Creek	3,769.5	40,575	0.04	0.10
Peterson Creek	3,233.0	34,800	...	0.15
North Hood Bay*	1,760.5	18,950	0.20	0.08
Big Bay Inlet 1**	17,070.0	183,750	0.03	...
Big Bay Inlet 2**	465.0	5,000	0.32	...
Olive Cove*	2,094.9	22,550	0.33	...
Luck Creek**	6,271.0	67,500	0.12	0.08
Luck Creek Tributary**	1,115.0	12,000	0.40	0.18
Red Lake Inlet*	1,135.7	12,225	0.32	0.55
Hill Creek Slough*	2,965.8	31,925	0.38	0.36
Logjam Slough**	3,716.0	40,000	...	0.21
Cabin Slough**	2,323.0	25,000	...	0.36

* Surface area estimated using measured trapezoids.

** Surface area estimated using paces (see Techniques Used section).

*** Does not include coho salmon $\leq$55 mm (2.17 in) in length.

Table V. Mean lengths and standard deviations of Dolly Varden and coho salmon from minnow trapping data.

Study Area	DOLLY VARDEN			COHO SALMON*		
	Sample size	Mean Length (mm)	Standard Deviation	Sample size	Mean Length (mm)	Standard Deviation
Switzer Creek (April)	96	77.8	15.5	...	...	...
Jordan Creek (May)	8	88.9	14.0	171	84.4	18.1
Jordan Creek (July)	90	117.5	19.5	168	80.0	8.7
Jordan Creek (August)	72	119.6	24.0	131	80.9	7.6
Montana Creek (August)	16	105.7	27.4	94	79.6	7.9
Peterson Creek (August)	...	...	...	91	79.9	16.0
North Hood Bay (August)	167	88.6	21.1	27	64.0	9.5
Big Bay Inlet #1 (June)	84	81.7	22.5	...	...	...
Big Bay Inlet #2 (June)	66	81.8	18.0	...	...	...
Olive Cove (July)	223	96.0	14.8	...	...	...
Luck Creek (June)	196	75.9	16.0	130	69.4	7.4
Luck Creek Trib. (June)	94	69.8	12.8	54	69.1	9.1
Red Lake Inlet (July)	108	86.3	18.8	132	88.4	15.9
Flicker Creek (July)	116	77.9	12.0	69	83.4	6.5
Hill Creek Slough (Aug)	259	86.6	17.3	198	75.2	11.6
Hill Creek Slough (Oct)	142	61.4	12.5	252	62.3	6.4
Logjam Slough (October)	18	75.0	24.1	85	66.2	8.6
Cabin Slough (October)	34	56.6	6.4	119	59.9	4.3

* Does not include coho salmon $\leq$55 mm (2.17 in) in length.